TCCD 59-1

AIRCRAFT MAINTENANCE IN A THEATER ARMY

INTRODUCTION AND BRIEF OF THE STUDY

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PART I

The tremendous problem of being able to logistically support Army aircraft in a combat situation prompted the requirement for this study. How it should be done, by whom, how many, where, with what - all were a part of the problem. Within the basic environment of future warfare the many factors in the complete system and their interrelationship had to be examined. It was soon found that no one factor could readily be solved independently because of its affect on the others. Separation of all these factors and determination of which were relevant and which were not was a monumental task. Consider for a moment that there are approximately 150,000 line items in support of Army aircraft maintenance. These items have been placed, by demand, into our supply system. Now, each of these items is there because someone asked for it. These items still do not represent the total parts contained in all the aircraft, but only represent those that have been demanded.

Now consider an overseas combat operation. It is obvious that each of these parts cannot be taken; there must be a cut-off somewhere. Depending on the types of aircraft to be supported, a cut-off point is selected and quantities of certain parts assigned as a stockage objective. If the estimate is wrong, which most surely it will be as the odds are so great, then there is the recourse of ordering those items from the 150,000 in CONUS. This takes time and meanwhile for almost every item not available there may be an aircraft which is not performing its combat mission. If

available, the part will be forwarded immediately; if not in stock, procurement action will be initiated. Long exposure to supply systems has created a different impression in each user's mind as to its degree of responsiveness.

To determine how good or poor this system is, the measure of effectiveness is determined by a percentage of requisitions filled. If 95% of the requisitions are filled consistently, this may be an indication of a good system, but 5% of 150,000 line items is still 7,500 line items and any one of them might ground an aircraft. In actual practice, this is not exactly true, but each part that is not in the system and those stocked in insufficient quantities must be considered. It becomes clearly evident, then, that no matter what is done in our present operation, the odds are that the combat commander is certain to have some of his aircraft out of service due to a lack of parts.

After a detailed review of the system, this study proposes to make it possible for a commander to have parts immediately available for all his aircraft. By taking advantage of the nature of parts usage (some parts are used frequently, while many thousands are used only once in a full year), the study proposes to take 3,000 line items to support a field army with 1,645 aircraft and obtain the remaining 147,000 line items from attrited or least economically reparable aircraft.

This, in essence, is the solution of the parts problem proposed by the study. This proposal may not be new, since it is known that present regulations permit cannibalization - <u>but nobody is practicing cannibalization</u> in maintaining Army aircraft, except in few isolated instances. The proposed

system is less costly in personnel, parts, aircraft, etc., measured dollar-wise, which may not be important in time of war. But what must be considered is that peacetime expenditures are dependent upon budgetary considerations and that there will be on hand on the day the war begins only those 150,000 line items in such quantities as could be procured within the limited peacetime budget. No amount of money will buy what is required on D/1, D/30, or D/90 if the lead time is 180 days or more.

Where the work should be done, how, by how many people, what organization, etc., is all developed in the study - complete with the details. It is believed that this is the first time that actual data developed from facts have been applied to the problem. Army personnel with a background of WW II and Korean experience in flying and maintaining aircraft worked alongside the study group. It is true that a study does not provide proof that the end product will work; however, the study appears to provide a logical, workable solution.

PART II - STUDY BRIEF

1. The purpose of this study was to develop a method to determine and evaluate the best aircraft maintenance system for use by the Army in the field. Its principal objective was not to solve the problem for any one specific set of conditions but to develop a procedure by which Army personnel can arrive at the best solution for any specific set of conditions.

2. In analyzing requirements it was found that in any specific situation there are two different sets of factors: Uncontrollable (those dictated by the situation) and Controllable (those which personnel charged with the maintenance mission can vary).

a. Uncontrollable factors are:

(1) The size of force - which establishes the type and number of aircraft.

(2) The flying hours programmed.

(3) The attrition rate.

(4) The total number and skill level of maintenance personnel and TOE equipment provided by specific mission orders.

b. Controllable factors are:

(1) Parts - selection of the best parts list to support the number and types of aircraft assigned and their programmed flying hours.

(2) Shops - the physical location and arrangement of TOE units and equipment authorized to support the mission, and the assignment and control of maintenance personnel.

(3) Aircraft - the total number of aircraft required to support the mission, to include adequate maintenance float and replacement aircraft for predictable attrition losses. (The analysis made by the contractor shows that present TOE's do not authorize adequate aircraft to perform the mission if published attrition rates are factual.)

3. After isolation of the three controllable factors, the contractor treated each separately:

Parts.

(1) The parts requirements solution was based on parts actually used rather than those stocked or issued. A detailed analysis was made of parts stocked and used by the Hayes contractor, in support of aircraft at Fort Rucker, during FY 1959. After deletion of common hardware and bulk material, the following pattern was revealed:

Line items stocked - to support 10 aircraft types	-	15,200
Line items used - 12 mo. period	-	6,700
Line items not used - 12 mo. period	-	8,500

(It is interesting to note that 56% of all line items stocked had no usage. This clearly demonstrates the vast difference between stockage and actual usage.)

(2) Parts used by five aircraft types assigned in sizeable quantities at Fort Rucker and also in the field army, were then rank ordered. It was determined that approximately 50 percent of all parts used were in quantities of one to four in a full year. (The full impact of this becomes evident when consideration is given to the fact that approximately 22 percent

of the line items stocked would have supported the flying hours if some source for obtaining low usage parts could be devised.) The parts usage pattern for these five aircraft types was as follows:

Line items used once (full year)	758
Line items used twice	458
Line items used three times	258
Line items used four times	209

(3) A full analysis was made of five aircraft types, to include the number assigned, hours flown, number of different line items used, the cumulative cost of one of each line item used and the purchase cost of each aircraft. This analysis produced the following results in support of flying hours accomplished during FY 59.

TYPE	AVERAGE NO. ASGD	HRS FLOWN	LINE ITEMS USED	COST, ONE OF EA. LINE ITEM	PURCHASE COST OF A/C
L-19	135	84,500	844	$ 35,000	$ 12,000
L-20	27	21,200	546	31,900	47,000
H-13	61	11,900	854	70,900	41,450
H-21	38	14,000	632	196,900	250,540
H-34	34	15,800	609	159,700	195,800

The two underlined costs in Column 5 (cost of one of each line item) are particularly interesting. For these two aircraft - the L-19 and H-13 - the catalog cost of one of each line item used exceeds the cost of a complete aircraft.

(4) The full cost of a line item in the system is composed of many factors not included in the catalog list price. These factors contain

so many variables that it is impossible to determine a specific cost figure. Some indications of these costs, which amount to several thousand dollars per line item, are contained in Appendix 6C, pages 150-153. If even the most optimistic evaluation is applied to these costs, it is readily apparent that any reduction in line items stocked will provide a great saving.

(5) The study results show that the parts line items used to support the flying hour program for a full year can be divided into three distinct categories.

(a) High cost line items account for approximately 90% of the catalog parts costs. There are only 97 high cost line items included in this 90% of cost, for the five aircraft types fully analyzed (see lists page 88). The contractor logically projects this figure as 200 for the ten aircraft types found in the field army. These items must be stocked; however, the study recommends stockage in minimum quantities with tight personalized control.

(b) The second category of parts, medium to high usage - low cost, is made up of about 2800 different line items that have an average catalog cost of approximately $2.00. Since these are high usage items, they too must be stocked. The study recommends that this stockage be accomplished in such quantities that a shortage is virtually impossible.

(c) The third category is those parts that are found to be low usage. In this category there are many thousands of possibilities for failure and any one is, individually, non-predictable for any specific period of time. The choice of stockage, for any specific mission then

becomes either stock all possible failures (numbering in the thousands) or stock none and provide actual needs from another source. From a non-technical analysis of the line items that make up the low usage (one to four) line items, it appears that most of these are items that are non-wearing and that failure is caused by breakage, faulty material, or poor handling techniques. The contractor recommends that these be obtained from salvage of damaged aircraft. If this procedure does not provide adequate low usage items, then the recommendation is that the remaining items be obtained from cannibalization of the least economically reparable aircraft in the serviceable inventory. This latter is less costly for at least the L-19 and H-13 aircraft where the catalog cost of <u>one</u> of each line item <u>used</u> exceeds the purchase price of a new aircraft.

(6) It is recognized that some of the procedures recommended by the contractor would require changes in current regulations. For example, funds not used for purchase of parts cannot automatically be used to purchase additional aircraft. There is, however, every indication that this procedure, if authorized, would cost far less than today's system where an attempt is made to stock parts for all possible failures. When an analysis is made of the possible limited engagements that may arise at any future date, and of the limited transport available to move the support equipment to an overseas area, it becomes apparent that reduction of all non-essential bulk is second only to providing the bare essentials. The possibility of reducing the great number of line items indicated by the procedures of this study cannot be ignored. The fact

that present regulations would require changes, becomes a problem of implementation and one that must be considered if the savings indicated are even partially realistic. It should be noted that the study was accomplished to support a force in an active theater and that its value to CONUS operations can only be determined by future developments.

b. The second factor, "Shops," their location, number to be established, and the most economical mix of maintenance personnel, was solved as follows: The location of shops was determined by balancing the cost of flying hours required to bring the aircraft to the shops - and - the total cost of the shops complex. Delivery costs can be expressed either in dollars per flying hour, or in non-productive flying hours. The cost of shops can be expressed in either dollar costs for equipment and personnel, or in requirements for personnel and the total amount of equipment and parts necessary to support the mission. According to the results obtained by the contractor, any central location is less costly than either extreme forward support (which requires excessive numbers of shop locations, personnel and parts fragmentation) or consolidated shops located at extreme distances to the rear. The cost per flying hour or non-productive flying hours expended to bring equipment to far distant shop locations will quickly outstrip the savings accomplished by consolidation.

c. The third controllable factor, "Total aircraft required to support the mission," is basically a problem that has no solution other than cooperation between maintenance requirements and using units. Replacement aircraft required for attrition and for aircraft grounded

for maintenance, increase proportionally with the demands of dispersion of forces and the type of usage visualized in future actions. A support plan can only survive if the programmed use of equipment is basically observed. If the additional aircraft provided for replacement are used to outfly the program, then the support system is bound to fail. Published attrition rates were used throughout the study, and it was determined that TOE authorizations for aircraft do not provide adequate aircraft to maintain programmed flying. Additional aircraft were proposed by the contractor to meet these shortcomings and to provide replacements for aircraft in maintenance. This solution is only valid if these aircraft are allowed to remain in the system to accomplish their intended purpose. The system cannot provide adequate support if using organizations are allowed to habitually use these extra aircraft to accomplish unprogrammed flying. The proposed solution, however, has a hidden benefit in that it provides a number of extra aircraft that would be available in a true emergency.

4. This study provides a method by which a solution for any specific situation can be obtained. It is not a cure-all for all conceivable problems; however, there is every indication that short term limited war situations as well as large scale operations could be supported by the procedures recommended. Given the numbers and types of aircraft to be supported for the specific mission, two hours of computation using simple arithmetic will provide the answers for the three controllable factors.